CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
BTEX	benzene, toluene, ethylbenzene, and xylenes
CLP	Contract Laboratory Program
EPA	U.S. Environmental Protection Agency
PCB	polychlorinated biphenyl
RI/FS	remedial investigation and feasibility study
SOW	statement of work
SVOC	semivolatile organic compound
TAL	target analyte list
TIC	tentatively identified compound
TCL	target compound list
VOC	volatile organic compound

SUPPLEMENTAL SEDIMENT SAMPLING AT ONONDAGA LAKE—EAST FLUME

This report summarizes the results of chemical analyses conducted on surface sediment samples from the East Flume at Onondaga Lake. The sampling was conducted to determine the concentrations of chlorobenzenes and other substances of concern in the East Flume so that an evaluation of the potential effects of these substances on fishes and wildlife in the area could be performed. The sampling was conducted in accordance with procedures described in the *Onondaga Lake RI/FS Supplemental Sampling Plan-East Flume Sediments* (PTI 1993b) and followed appropriate procedures established for the Onondaga Lake remedial investigation and feasibility study (RI/FS) study. These results should be considered as an addendum to the *Onondaga Lake RI/FS Substance Distribution Investigation Data Report, Volume I* (PTI 1993a).

SAMPLING LOCATIONS AND FREQUENCY

Sediment samples were collected at five stations below the spillway in the East Flume (Figure 1) on August 24, 1993. At each station, three surface sediment samples (0–2 cm depth) were collected along a transect across the flume channel. Sampling points were at the south end, middle, and north end of the transect. Two samples were analyzed for site metals, site volatile organic compounds, chlorinated benzenes, and polychlorinated biphenyls (PCBs). The third sample was analyzed for target analyte list (TAL) metals and cyanide and target compound list (TCL) organic compounds. In addition, all surface sediment samples were analyzed for selected conventional parameters.

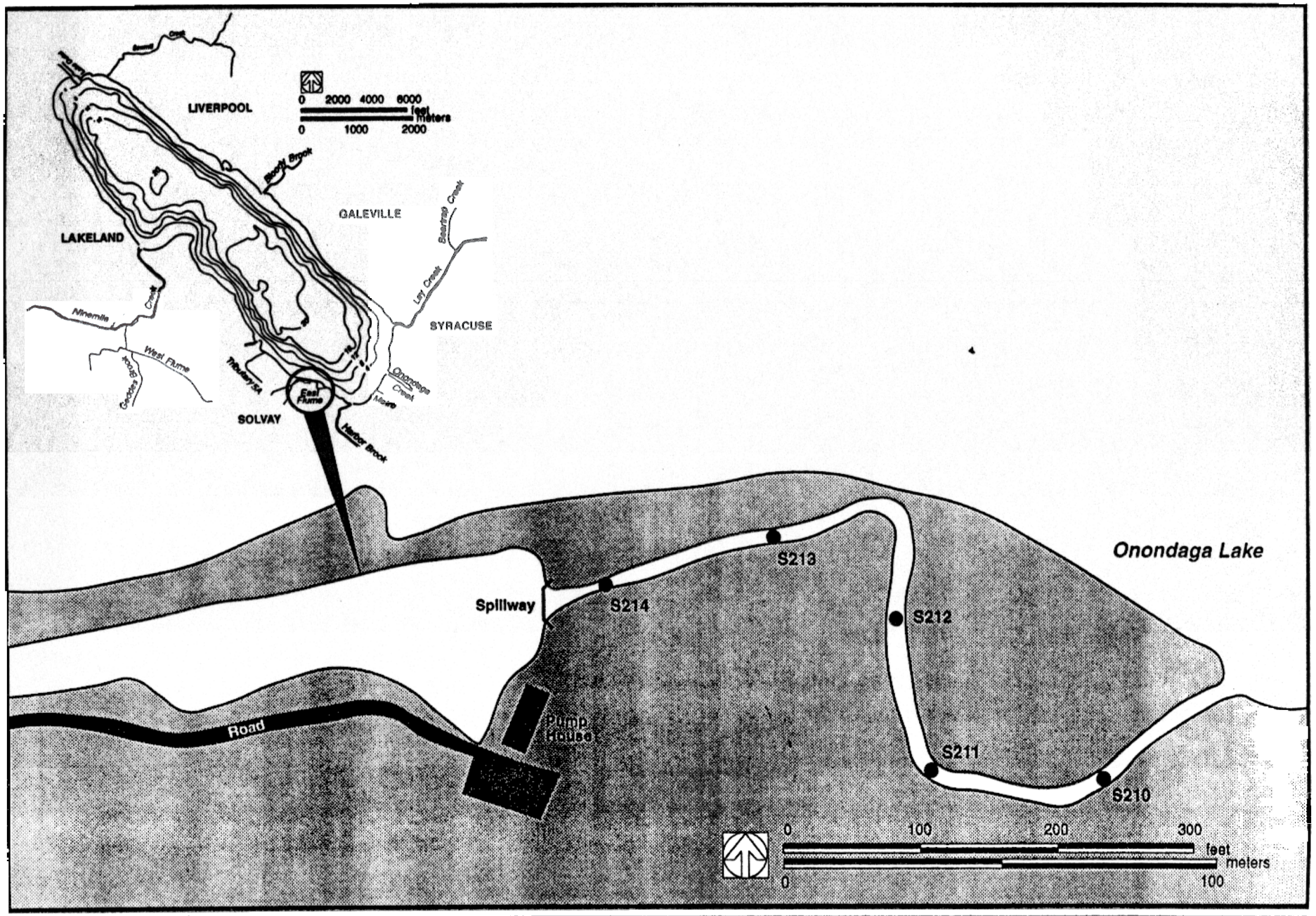

Figure 1. East Flume sediment sampling locations.

FIELD METHODS

Surface sediment samples were collected in accordance with the field methods titled *Surficial Sediment Sampling Using a van Veen Grab Sampler* (Appendix B, PTI 1993a).

LABORATORY METHODS

The analytical methods used for the supplemental East Flume surface sediment study are summarized below.

Conventional Analytes

Surface sediment samples were analyzed for calcium carbonate by gravimetric analysis (Dean 1974), chloride by U.S. Environmental Protection Agency (EPA) Method 325.1 (U.S. EPA 1983), total organic carbon by Wakley-Black titration (Piper 1942), grain-size distribution by sieving (Plumb 1981), and percent moisture by American Society of Testing and Materials (ASTM) Method D2216-80 (ASTM 1989).

Site and Target Analyte List Metals

The analyses for site metals (cadmium, calcium, chromium, copper, lead, magnesium, total mercury, nickel, sodium, and zinc) and TAL metals and cyanide were completed in accordance with the Contract Laboratory Program (CLP) statement of work (SOW) ILM02. (U.S. EPA 1991a).

Site and Target Compound List Volatile Organic Compounds

The analyses for site volatile organic compounds (VOCs) were completed using a modified version of CLP SOW OLM01.8 (U.S. EPA 1991b). The modified list of target analytes included benzene, toluene, ethylbenzene, total xylenes (BTEX), monochlorobenzene, dichlorobenzenes (1,2-, 1,3-, and 1,4-isomers) and trichlorobenzenes (1,2,3-, 1,2,4-, and 1,3,5-isomers). The analyses for TCL VOCs were completed in accordance with CLP SOW OLM01.8 (U.S. EPA 1991b).

Target Compound List Semivolatile Organic Compounds

The analyses for TCL semivolatile organic compounds (SVOCs) were completed in accordance with CLP SOW OLM01.8 (U.S. EPA 1991b).

Target Compound List Pesticides and Polychlorinated Biphenyls

The analyses for TCL pesticides and PCBs were completed in accordance with CLP SOW OLM01.8 (U.S. EPA 1991b).

Polychlorinated Biphenyls and Chlorinated Benzenes

The analyses for PCBs were completed in accordance with EPA SW-846 Method 8080 (U.S. EPA 1986), modified to include only PCBs as target compounds. The analyses for chlorinated benzenes were completed in accordance with a modification of EPA SW-846 Method 8120 (U.S. EPA 1986). The modified list of compounds included the analysis of three tetrachlorobenzene isomers, pentachlorobenzene, and hexachlorobenzene only.

SUMMARY OF DATA QUALITY

The following sections describe the results of the quality assurance reviews performed on the analytical data for the supplemental East Flume surface sediment study. Complete quality assurance reports are presented in Appendix A.

Some of the results summarized in Tables 1-10 were qualified as estimates (*J*) during the quality assurance review. As noted in U.S. EPA (1989): "The *J*-qualifier is placed on CLP data to provide important information about an analysis to a data user or decision-maker, not to indicate low confidence in the analysis." Also noted in U.S. EPA (1989): "The *J*-qualifier is a quantitative qualifier and can mean: 1) the target analyte is definitely present, 2) the sample was difficult to analyze, 3) the value may lie near the low end of the linear range of the instrument, and 4) the value should nearly always be seriously considered in decision-making."

Conventional Analyses

A total of 105 analytical results were reported by the laboratory, all at concentrations above the detection limit. No data were qualified or rejected during the quality assurance review.

Site and Target Analyte List Metals

A total of 100 analytical results for site metals and 120 analytical results for TAL metals and cyanide were reported by the laboratory. Of these results, 90 site and 95 TAL metals were reported at concentrations above the detection limit and 10 site and 25 TAL metals were reported as undetected.

During the quality assurance review, 37 results were qualified as estimated (i.e., a *J* qualifier was attached to each result) because one or more of the following criteria were not met: initial calibration, serial dilution, post digestion spike, matrix spike, and/or laboratory duplicate. All results qualified as estimates have an acceptable degree of uncertainty for use in the RI/FS.

Site and Target Compound List Volatile Organic Compounds

A total of 110 analytical results for site VOCs and 165 analytical results for TCL VOCs were reported by the laboratory. Of these results, 56 site and 23 TCL VOCs were reported at concentrations above the quantification limit, 34 site and 133 TCL VOCs were reported as undetected, and 20 site and 9 TCL VOCs were reported at concentrations below the quantification limit.

All results reported as detected at concentrations below the quantification limit were qualified as estimated (i.e., a *J* qualifier was attached to each result by the laboratory). During the quality assurance review, 11 TCL VOC results were restated as undetected because of blank contamination. All results qualified as estimates have an acceptable degree of uncertainty for use in the RI/FS.

Several tentatively identified compounds (TICs) were detected in the samples. TICs are non-target compounds, and all TIC results should be considered as estimates both qualitatively and quantitatively. All TIC results are qualified *J*.

Target Compound List Semivolatile Organic Compounds

A total of 320 analytical results were reported by the laboratory. Of these results, 41 were reported at concentrations above the quantification limit, 217 were reported as undetected, and 62 were reported at concentrations below the quantification limit. All

results reported at concentrations below the quantification limit were qualified as estimated (i.e., a *J* qualifier was attached to each result by the laboratory). All results qualified as estimated have an acceptable degree of uncertainty for use in the RI/FS.

Several TICs were detected in the samples. TICs are non-target compounds, and all TIC results should be considered as estimates both qualitatively and quantitatively. All TIC results are qualified *J*.

Target Compound List Pesticides and Polychlorinated Biphenyls

A total of 140 analytical results were reported by the laboratory. All of these results were reported as undetected. No data were qualified or rejected.

Polychlorinated Biphenyls and Chlorinated Benzenes

A total of 70 analytical results for PCB and 50 analytical results for chlorinated benzene were reported by the laboratory. Seven PCB and 40 chlorinated benzene results were reported at concentrations above the quantification limits, 54 PCB and 10 chlorinated benzene results were reported as undetected, and 9 PCB results were reported at concentrations below the quantification limit. All 9 PCB results reported at concentrations below the quantification limit were qualified as estimated (i.e., a *J* qualifier was attached to each result by the laboratory). During the quality assurance review, 40 detected and 10 undetected chlorinated benzene results were qualified as estimated (i.e., a *J* qualifier was attached to each result) because holding time criteria were not met. All results qualified as estimated have an acceptable degree of uncertainty for use in the RI/FS.

RESULTS

The results for the East Flume surface sediment samples are presented in Tables 1-10.

REFERENCES

ASTM. 1989. Soil and rock; building stones; geotech styles. Volume 04.08. American Society for Testing and Materials, Philadelphia, PA.

Dean, W.E. 1974. Determination of carbonate and organic matter in calcareous sediments and sedimentary rock by loss or ignition: comparison with other methods. J. Sediment. Petrol. 44:242-248.

Piper, C.S. 1942. Soil and plant analysis. University of Adelaide, Adelaide, South Australia.

Plumb, R.H. 1981. Procedure for handling and chemical analysis of sediment and water samples. Technical Report EPA/CE-81-1. U.S. Environmental Protection Agency and U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

PTI. 1993a. Onondaga Lake RI/FS substance distribution investigation data report. Volumes I and II. Prepared for AlliedSignal Inc., Solvay, NY. PTI Environmental Services, Bellevue, WA.

PTI. 1993b. Onondaga Lake RI/FS supplemental sampling plan—East Flume sediments. Prepared for AlliedSignal Inc., Solvay, NY. PTI Environmental Services, Bellevue, WA.

U.S. EPA. 1983. Methods for chemical analysis of water and wastes. EPA-600/4-79-020. U.S. Environmental Protection Agency, Washington DC.

U.S. EPA 1986. Test methods for evaluating solid waste. SW-846. Third edition. U.S. Environmental Protection Agency, Washington DC.

U.S. EPA. 1989. *J*-qualified CLP data and recommendations for its use. Memorandum from Howard M. Fribush, Technical Project Officer, Analytical Operations Branch, to Suzanne Wells, Chief, NPL Criteria Section, Site Assessment Branch. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA 1991a. Contract Laboratory Program statement of work for inorganics analysis, multi-media, multi-concentration. Revision ILM02.1. U.S. Environmental Protection Agency, Washington DC.

U.S. EPA 1991b. Contract Laboratory Program statement of work for organics analysis, multi-media, multi-concentration. Revision OLM01.8. U.S. Environmental Protection Agency, Washington DC.

TABLES

TABLE 1. EAST FLUME SEDIMENT – CONVENTIONAL ANALYTES

Sample Number	Station	Date	Sample ID	Calcium Carbonate (percent dry)	Chloride (mg/kg dry)	Organic Carbon (percent dry)	Percent Sand (percent whole)	Percent Silt (percent whole)	Percent Clay (percent whole)	Percent Moisture (percent whole)
S20001	S210	08/24/93	S210S	86.4	2,640	1.5	11	19.1	1.2	68.7
S20002	S210	08/24/93	S210M	83.3	11,000	1.4	3.4	22.4	1.8	72.6
S20003	S210	08/24/93	S210N	84.5	1,980	1.5	10	19.4	4.2	66.6
S20004	S211	08/24/93	S211S	78.7	5,480	2.2	3.3	18.7	3.9	72.8
S20005	S211	08/24/93	S211M	78.3	7,080	2.4	1.1	17.4	1.8	79.7
S20006	S211	08/24/93	S211N	76.7	8,970	2.1	2.5	17	2.7	78
S20007	S212	08/24/93	S212S	62	1,280	4.7	6.2	10.9	2.4	80.1
S20008	S212	08/24/93	S212M	70.8	1,800	2.9	2.9	14.4	4.1	78.9
S20009	S212	08/24/93	S212N	71.1	1,540	3.6	4	15.7	4.6	75.7
S20010	S213	08/24/93	S213N	64.4	552	1.9	38.3	3.4	1.2	56.7
S20011	S213	08/24/93	S213M	67.2	441	1.1	52	2	1	46.9
S20012	S213	08/24/93	S213S	59.3	3,220	2	4.5	11.3	1.3	87.4
S20013	S214	08/24/93	S214S	61.6	11,000	3.8	5.9	11.2	1.2	82.8
S20014	S214	08/24/93	S214M	62.2	7,210	3.2	4.7	9.7	5.2	80.1
S20015	S214	08/24/93	S214N	63.4	11,700	4.7	4.7	5.9	2.6	82.7

TABLE 2. EAST FLUME SEDIMENT – SITE METALS

Sample Number	Station	Date	Sample ID	Cadmium (mg/kg dry)	Calcium (mg/kg dry)	Chromium (mg/kg dry)	Copper (mg/kg dry)	Lead (mg/kg dry)	Magnesium (mg/kg dry)	Total Mercury (mg/kg dry)	Nickel (mg/kg dry)	Sodium (mg/kg dry)	Zinc (mg/kg dry)
S20001	S210	06/24/93	S210S	1.1 *U*	355,000	8.1	8.8	17.6 *J*	9,270	0.96	3.9 *U*	2,920	115 *J*
S20002	S210	06/24/93	S210M	1.3 *U*	347,000	9.9	11.8	16.7 *J*	12,600	1	4.5 *U*	7,080	95.4 *J*
S20004	S211	06/24/93	S211S	1.2 *U*	330,000	12.6	18.7	26.9 *J*	17,200	1.1	6.8	6,100	118 *J*
S20005	S211	06/24/93	S211M	1.5 *U*	326,000	9.1	13.5	15.2 *J*	25,400	0.81	5.6	7,520	112 *J*
S20007	S212	06/24/93	S212S	1.5 *U*	289,000	35.8	54.4	59.8 *J*	10,200	5.3	22.5	2,370	286 *J*
S20008	S212	06/24/93	S212M	1.5 *U*	307,000	19.3	32.3	37.5 *J*	12,000	3	11	2,420	224 *J*
S20010	S213	06/24/93	S213N	0.91 *J*	222,000	21.6	87.2	32.2 *J*	9,110	7.5	21	1,260	265 *J*
S20011	S213	06/24/93	S213M	0.73 *J*	181,000	14.6	42	36.9 *J*	6,730	3.4	18	987	149 *J*
S20013	S214	06/24/93	S214S	1.7 *U*	305,000	22.2	40.1	49.3 *J*	12,400	3.2	13.4	8,170	247 *J*
S20014	S214	06/24/93	S214M	1.5 *U*	280,000	26.2	36.5	49.4 *J*	14,100	2.7	13.3	6,760	324 *J*

Note: *J* – estimated
U – undetected

M – midstream
N – north side of stream transect
S – south side of stream transect

TABLE 3. EAST FLUME SEDIMENT – SITE VOLATILE ORGANIC COMPOUNDS

Sample Number	Station	Date	Sample ID	Benzene (µg/kg dry)	Toluene (µg/kg dry)	Ethylbenzene (µg/kg dry)	Xylene Isomers (µg/kg dry)	Chlorobenzene (µg/kg dry)	1,2-Dichloro-benzene (µg/kg dry)	1,3-Dichloro-benzene (µg/kg dry)	1,4-Dichloro-benzene (µg/kg dry)	1,2,3-Trichloro-benzene (µg/kg dry)
S20001	S210	08/24/93	S210S	100	160	10 *J*	260	12 *J*	33	15 *U*	43	15 *U*
S20002	S210	08/24/93	S210M	2,100 *U*	550 *J*	2,100 *U*	670 *J*	830 *J*	9,500	2,100 *U*	7,600	910 *J*
S20004	S211	08/24/93	S211S	26	95	24	270	31	310	17 *U*	270	9 *J*
S20005	S211	08/24/93	S211M	56	150	37	420	55	500	15 *J*	410	32
S20007	S212	08/24/93	S212S	23 *U*	23 *U*	23 *U*	23 *U*	14 *J*	71	23 *U*	96	23 *U*
S20008	S212	08/24/93	S212M	13 *J*	26	23 *U*	91 *U*	77	390	20 *J*	300	43
S20010	S213	08/24/93	S213N	12 *U*	3 *J*	12 *U*	12 *U*	7 *J*	18	12 *U*	33	12 *U*
S20011	S213	08/24/93	S213M	9 *U*	9 *U*	9 *U*	6 *J*	15	53	5 *J*	63	9 *U*
S20013	S214	08/24/93	S214S	82	190	66	1,500	260	810	32	980	30
S20014	S214	08/24/93	S214M	1,300 *J*	4,600 *J*	5,700 *U*	12,000	36,000	120,000	14,000	160,000	3,700 *J*

Sample Number	Station	Date	Sample ID	1,2,4-Trichloro-benzene (µg/kg dry)	1,3,5-Trichloro-benzene (µg/kg dry)
S20001	S210	08/24/93	S210S	15 *U*	11 *J*
S20002	S210	08/24/93	S210M	2,100 *U*	3,300
S20004	S211	08/24/93	S211S	17 *U*	33
S20005	S211	08/24/93	S211M	24 *U*	110
S20007	S212	08/24/93	S212S	23 *U*	23 *U*
S20008	S212	08/24/93	S212M	23 *U*	160
S20010	S213	08/24/93	S213N	12 *U*	5 *J*
S20011	S213	08/24/93	S213M	9 *U*	11
S20013	S214	08/24/93	S214S	28 *U*	140
S20014	S214	08/24/93	S214M	5,700 *U*	15,000

Note: *J* – estimated
U – undetected

M – midstream
N – north side of stream transect
S – south side of stream transect

TABLE 4. EAST FLUME SEDIMENT – POLYCHLORINATED BIPHENYLS

Sample Number	Station	Date	Sample ID	Aroclor® 1016 (µg/kg dry)	Aroclor® 1221 (µg/kg dry)	Aroclor® 1232 (µg/kg dry)	Aroclor® 1242 (µg/kg dry)	Aroclor® 1248 (µg/kg dry)	Aroclor® 1254 (µg/kg dry)	Aroclor® 1260 (µg/kg dry)
S20001	S210	08/24/93	S210S	53 U	53 U	53 U	53 U	53 U	53 U	53 U
S20002	S210	08/24/93	S210M	61 U	61 U	61 U	61 U	39 J	61 U	35 J
S20004	S211	08/24/93	S211S	61 U	61 U	61 U	61 U	55 J	61 U	49 J
S20005	S211	08/24/93	S211M	81 U	81 U	81 U	81 U	53 J	81 U	81 U
S20007	S212	08/24/93	S212S	83 U	83 U	83 U	83 U	130	83 U	170
S20008	S212	08/24/93	S212M	78 U	78 U	78 U	78 U	48 J	78 U	78 U
S20010	S213	08/24/93	S213N	39 U	39 U	39 U	39 U	100	39 U	94
S20011	S213	08/24/93	S213M	31 U	31 U	31 U	31 U	120	31 U	180
S20013	S214	08/24/93	S214S	95 U	95 U	95 U	95 U	90 J	95 U	74 J
S20014	S214	08/24/93	S214M	81 U	81 U	81 U	81 U	83	81 U	45 J

Note: J – estimated
U – undetected

M – midstream
N – north side of stream transect
S – south side of stream transect

TABLE 5. EAST FLUME SEDIMENT – CHLORINATED BENZENES

Sample Number	Station	Date	Sample ID	1,2,3,4-Tetrachloro-benzene (µg/kg dry)	1,2,3,5-Tetrachloro-benzene (µg/kg dry)	1,2,4,5-Tetrachloro-benzene (µg/kg dry)	Pentachloro-benzene (µg/kg dry)	Hexachloro-benzene (µg/kg dry)
S20001	S210	08/24/93	S210S	28 J	5.3 UJ	9 J	10 J	39 J
S20002	S210	08/24/93	S210M	46 J	6.1 UJ	19 J	16 J	61 J
S20004	S211	08/24/93	S211S	58 J	6.1 UJ	24 J	23 J	75 J
S20005	S211	08/24/93	S211M	33 J	6.1 UJ	16 J	12 J	37 J
S20007	S212	08/24/93	S212S	210 J	25 UJ	80 J	67 J	220 J
S20008	S212	08/24/93	S212M	61 J	7.8 UJ	24 J	16 J	49 J
S20010	S213	08/24/93	S213N	130 J	20 UJ	34 J	52 J	250 J
S20011	S213	08/24/93	S213M	120 J	15 UJ	36 J	36 J	180 J
S20013	S214	08/24/93	S214S	110 J	9.5 UJ	66 J	38 J	110 J
S20014	S214	08/24/93	S214M	240 J	24 UJ	150 J	34 J	86 J

Note: *J* – estimated
U – undetected

M – midstream
N – north side of stream transect
S – south side of stream transect

TABLE 6. EAST FLUME SEDIMENT – TARGET ANALYTE LIST METALS AND CYANIDE

	Sample No.:	S20003	S20006	S20009	S20012	S20015
	Station No.:	S210	S211	S212	S213	S214
	Sampling Date:	08/24/93	08/24/93	08/24/93	08/24/93	08/24/93
Analyte	Sample ID:	S210N	S211N	S212N	S213S	S214N
Aluminum		1,280	1,640	4,030	5,410	3,380
Antimony		6.3 *U*	10.2 *U*	9.4 *U*	17.5 *U*	12.3 *U*
Arsenic		8	9.7	10.9	18.8	12.8
Barium		144	139	234	247	227
Beryllium		0.11	0.18 *U*	0.35	0.43	0.37
Cadmium		0.91 *U*	1.5 *U*	1.3 *U*	2.5 *U*	1.8 *U*
Calcium		334,000	292,000	297,000	230,000	260,000
Chromium		11.3	10.5	25.1	31.2	32.2
Cobalt		1.9	2.2	4.5	10.2	7.2
Copper		13.9	17.2	40.3	75.6	42.8
Cyanide		3.6	7	0.56	1.1	1.3
Iron		2,520	3,300	8,250	11,300	6,570
Lead		18	20.8	54.5	70.8	43.7
Magnesium		6,160	22,900	9,560	10,600	12,900
Manganese		181	198	269	267	237
Total mercury		7 *J*	1.8 *J*	4.7 *J*	3.6 *J*	2.8 *J*
Nickel		4.6	5.8	16.9	19.7	12.2
Potassium		193	436	676	807	1,010
Selenium		0.4 *UJ*	0.64 *UJ*	0.82 *J*	1.2 *UJ*	0.9 *UJ*
Silver		0.98 *U*	1.6 *U*	1.5 *U*	2.7 *U*	1.9 *U*
Sodium		1,870	7,560	2,140	3,160	8,240
Thallium		0.44 *U*	0.69 *U*	0.67 *U*	1.3 *U*	0.98 *U*
Vanadium		1.6	5	13.8	20.8	14.9
Zinc		139 *J*	123 *J*	252 *J*	643 *J*	356 *J*

Note: All concentrations reported as mg/kg dry weight.

J – estimated

U – undetected

N – north side of stream transect

S – south side of stream transect

TABLE 7. EAST FLUME SEDIMENT – TARGET COMPOUND LIST
VOLATILE ORGANIC COMPOUNDS

Analyte	Sample No.: S20003 Station No.: S210 Sampling Date: 08/24/93 Sample ID: S210N	S20006 S211 08/24/93 S211N	S20009 S212 08/24/93 S212N	S20012 S213 08/24/93 S213S	S20015 S214 08/24/93 S214N
Aromatic Hydrocarbons					
Benzene	47	26 J	36 U	16 J	5,600 U
Toluene	75	78	10 J	7 J	3,100 J
Ethylbenzene	5 J	20 J	36 U	8 J	5,600 U
Styrene	24 U	45 U	36 U	23 U	5,600 U
Xylene isomers	120	230	36 U	30	15,000
Chlorobenzene	100	48	160	150	35,000
Halogenated Alkanes					
Chloromethane	24 U	45 U	36 U	23 U	5,600 U
Bromomethane	24 U	45 U	36 U	23 U	5,600 U
Chloroethane	24 U	45 U	36 U	23 U	5,600 U
Methylene chloride	24 U	45 U	36 U	23 U	5,600 U
1,1-Dichloroethane	24 U	45 U	36 U	23 U	5,600 U
Chloroform	24 U	45 U	36 U	23 U	5,600 U
1,2-Dichloroethane	24 U	45 U	36 U	23 U	5,600 U
1,1,1-Trichloroethane	24 U	45 U	36 U	23 U	5,600 U
Carbon tetrachloride	24 U	45 U	36 U	23 U	5,600 U
Bromodichloromethane	24 U	45 U	36 U	23 U	5,600 U
1,2-Dichloropropane	24 U	45 U	36 U	23 U	5,600 U
Dibromochloromethane	24 U	45 U	36 U	23 U	5,600 U
1,1,2-Trichloroethane	24 U	45 U	36 U	23 U	5,600 U
Bromoform	24 U	45 U	36 U	23 U	5,600 U
1,1,2,2-Tetrachloroethane	24 U	45 U	36 U	23 U	5,600 U
Vinyl chloride	24 U	45 U	36 U	23 U	5,600 U
1,1-Dichloroethene	24 U	45 U	36 U	23 U	5,600 U
1,2-Dichloroethene isomers	24 U	45 U	36 U	23 U	5,600 U
cis-1,3-Dichloropropene	24 U	45 U	36 U	23 U	5,600 U
trans-1,3-Dichloropropene	24 U	45 U	36 U	23 U	5,600 U
Trichloroethene	24 U	45 U	36 U	5 J	5,600 U
Tetrachloroethene	24 U	45 U	36 U	23 U	5,600 U
Ketones					
Acetone	28 U	180 U	120 U	100 U	5,600 U
2-Butanone	24 U	45 U	36 U	23 U	5,600 U
2-Hexanone	24 U	45 U	36 U	23 U	5,600 U
4-Methyl-2-pentanone	24 U	45 U	36 U	23 U	5,600 U
Miscellaneous Volatile Compound					
Carbon disulfide	24 U	45 U	36 U	23 U	5,600 U

Note: All concentrations reported as µg/kg dry weight.
J – estimated
U – undetected

N – north side of stream transect
S – south side of stream transect

3,3'–Dichlorobenzidine	840 U	210 U		

Note: All concentrations reported as µg/kg dry weight.
J – estimated
U – undetected

N – north side of stream transect
S – south side of stream transect

ME SEDIMENT
E/POLYCHLORINA

Analyte	Sample No.: S20003 Station No.: S210 Sampling Date: 08/24/93 Sample ID: S210N	S20006 S211 08/24/93 S211N	S20009 S212 08/24/93 S212N	S20012 S213 08/24/93 S213S	S20015 S214 08/24/93 S214N
alpha–Hexachlorocyclohexane	3.8 U	7.5 U	6 U	4 U	7.9 U
beta–Hexachlorocyclohexane	3.8 U	7.5 U	6 U	4 U	7.9 U
delta–Hexachlorocyclohexane	3.8 U	7.5 U	6 U	4 U	7.9 U
gamma–Hexachlorocyclohexane	3.8 U	7.5 U	6 U	4 U	7.9 U
alpha–Chlordane	3.8 U	7.5 U	6 U	4 U	7.9 U
Aldrin	3.8 U	7.5 U	6 U	4 U	7.9 U
gamma–Chlordane	3.8 U	7.5 U	6 U	4 U	7.9 U
Dieldrin	7.4 U	15 U	12 U	7.8 U	15 U
alpha–Endosulfan (Endosulfan I)	3.8 U	7.5 U	6 U	4 U	7.9 U
beta–Endosulfan (Endosulfan II)	7.4 U	15 U	12 U	7.8 U	15 U
Endosulfan sulfate	7.4 U	15 U	12 U	7.8 U	15 U
Endrin	7.4 U	15 U	12 U	7.8 U	15 U
Endrin aldehyde	7.4 U	15 U	12 U	7.8 U	15 U
Endrin ketone	7.4 U	15 U	12 U	7.8 U	15 U
Heptachlor epoxide	3.8 U	7.5 U	6 U	4 U	7.9 U
Heptachlor	3.8 U	7.5 U	6 U	4 U	7.9 U
Methoxychlor	38 U	75 U	60 U	40 U	79 U
4,4'–DDD	7.4 U	15 U	12 U	7.8 U	15 U
4,4'–DDE	7.4 U	15 U	12 U	7.8 U	15 U
4,4'–DDT	7.4 U	15 U	12 U	7.8 U	15 U
Toxaphene	380 U	750 U	600 U	400 U	790 U
Aroclor® 1016	74 U	150 U	120 U	78 U	150 U
Aroclor® 1221	150 U	300 U	240 U	160 U	310 U
Aroclor® 1232	74 U	150 U	120 U	78 U	150 U
Aroclor® 1242	74 U	150 U	120 U	78 U	150 U
Aroclor® 1248	74 U	150 U	120 U	78 U	150 U
Aroclor® 1254	74 U	150 U	120 U	78 U	150 U
Aroclor® 1260	74 U	150 U	120 U	78 U	150 U

Note: All units reported as µg/kg dry weight.
J – estimated
U – undetected

N – north side of stream transect
S – south side of stream transect

TABLE 10. TENTATIVELY IDENTIFIED COMPOUNDS

Analyte	Sample No.:	S20003	S20006	S20009	S20012	S20015
	Station No.:	S210	S211	S212	S213	S214
	Sampling Date:	08/24/93	08/24/93	08/24/93	08/24/93	08/24/93
	Sample ID:	S210N	S211N	S212N	S213S	S214N
1-Methylnaphthalene		2,300 J	2,500 J	4,600 J	7 J	730 J
1-Propynyl-benzene		--	--	--	--	2,900 J
1,2,4-Trimethylbenzene		--	--	--	--	6,400 J
1-Ethyl-3-methyl-benzene		--	--	400 J	--	--
1-Iododecane		700 J	--	--	--	--
1-Methylpropyl-benzene		--	--	--	--	3,500 J
3-(2-phenylethenly)-benzenamine		1,200 J	--	980 J	--	--
9-Octylheptadecane		--	1,500 J	--	--	--
Hexadecane		--	830 J	--	520 J	--

Note: All concentrations reported as µg/kg dry weight.
-- = not identified
J = estimated

N = north side of stream transect
S = south side of stream transect

APPENDIX A

Quality Assurance Review Summaries

CONTENTS

LIST OF TABLES

BTEX	benzene, toluene, ethylbenzene, and xylenes
CLP	Contract Laboratory Program
CRDL	contract-required detection limit
CRI	ICP CRDL standard
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
GFAA	graphite furnace atomic absorption spectrometry
ICP	inductively coupled plasma-atomic absorption spectrometry
IDL	instrument detection limit
LCS	laboratory control sample
PCB	polychlorinated biphenyl
RPD	relative percent difference
SDG	sample delivery group
SOW	statement of work
SVOC	semivolatile organic compound
TCL	target compound list
TIC	tentatively identified compound
VOC	volatile organic compound

QUALITY ASSURANCE REVIEW SUMMARY—CONVENTIONAL ANALYTES IN SEDIMENT SAMPLES

A quality assurance review of laboratory data was completed for conventional analytes (calcium carbonate, chloride, total organic carbon, grain size, and percent moisture) in 15 surface sediment samples. These data are associated with the 1993 supplemental field investigation conducted at the East Flume, a tributary of Onondaga Lake (PTI 1993). All data are acceptable for the uses identified in the work plan (PTI 1991b).

SUMMARY OF QUALIFIED DATA

A total of 105 analytical results were reported by the laboratory for the 15 surface sediment samples. All results were acceptably reported at a concentration above the method detection limit. No data were qualified or rejected during the quality assurance review. A summary of results for quality control procedures employed by the laboratory is presented in Table A-1.

SAMPLE DELIVERY GROUPS

The 15 surface sediment samples were analyzed for conventional analytes in 2 sample delivery groups (SDGs) (Table A-2). The data packages for these SDGs contained all documentation and data necessary to perform a complete quality assurance review.

TABLE A-1. SUMMARY OF QUALITY CONTROL CHECKS — CONVENTIONAL ANALYTES

Quality Control Check	Status	Comment
Completeness	Acceptable	No data rejected
Holding times	Acceptable	
Analytical methods	Acceptable	
Instrument performance	Acceptable	
Initial calibration	Acceptable	
Initial and continuing calibration verification	Acceptable	
Initial and continuing calibratio-nation blanks	Acceptable	
Method blank analyses	Acceptable	
Accuracy (bias or recovery)		
Laboratory control sample recoveries	Acceptable	
Matrix spike recoveries	Acceptable	
Reference material recoveries	Not applicable	None submitted
Precision	Acceptable	
Analyte quantification and de-tection limits	Acceptable	
Field quality control samples	Not applicable	None submitted
OVERALL ASSESSMENT	**ACCEPTABLE**	**No qualifier codes were addedd to any results**

TABLE A-2. SAMPLES IN EACH SAMPLE DELIVERY GROUP— CONVENTIONAL ANALYTES

Station	Date	Sample ID	Type	Sample No.
	08/24/93	S210	LAKE-SEDT	S20001
	08/24/93	S210	LAKE-SEDT	S20002
	08/24/93	S211	LAKE-SEDT	S20004
	08/24/93	S211	LAKE-SEDT	S20005
	08/24/93	S212	LAKE-SEDT	S20007
	08/24/93	S212	LAKE-SEDT	S20008
	08/24/93	S213	LAKE-SEDT	S20010
	08/24/93	S213	LAKE-SEDT	S20011
	08/24/93	S214	LAKE-SEDT	S20013
	08/24/93	S214	LAKE-SEDT	S20014
	08/24/93	S210	LAKE-SEDT	S20003
	08/24/93	S211	LAKE-SEDT	S20006
	08/24/93	S212	LAKE-SEDT	S20009
	08/24/93	S213	LAKE-SEDT	S20012
	08/24/93	S214	LAKE-SEDT	S20015

DATA QUALITY ASSESSMENT

The specific quality trol results associated with the data discussed below including holding times methodology system performance, and analytical accuracy (bias and preci) Data quality was assessed in terms of U. Environmental Protection Agency (EPA Contract Laboratory Program (CLP) requirements where applicable) and data quality objectives (DQOs) established for this project (PTI 99).

Completeness

The results reported by the laboratory for all conven onal analyses were 00 percent complete and met the project DQOs No data rejected urin the uality assurance review

Holding Times

All analy holding time constraints and sample preservation requirements (PTI 99 a) met for all samples.

Analytical Methods

The analyses for conven onal analytes were completed using the methods indicated in the quality project plan (PTI 99

Instrument Performance

The results for the initial and continuing calibrati associated th all sediment sample analyses described bel

Initial Calibratio

The initial calibrations performed for all applicable conventional analyses met the teria for acceptable performance and frequency of analysi

Initial and Continuing Calibratio Verification

The tial and continuing calibrati verifications performed for all applicabl conventional analyses met the teria for acceptable performance and frequency of analysis

Initial and Continuing Calibratio Blanks

The initial and continuing calibration blanks anal zed for all applicable conventional analyses met the criteria for acceptable performance and frequency of analysis.

Method Blank Analyses

Ne target analytes were detected at concentration greater than 2 mes the method detection limi in an method blanks

ccuracy

The accuracy of the analytical results evaluated in the following sections in terms of anal tical bias (laboratory control sample [LCS matrix spike and reference material recoveries and precision (laboratory duplicates)

Laboratory Control Sample Recoveries

The recoveries reported for all LCS analyses met the teria for acceptable performance and frequency of analy A summary of LCS recoveries is presented in Table A-3.

Matrix Spike Recoveries

The eries reported for all matrix spike analy met the teria for acceptable performance and frequency of analysis A summary of matrix spike recoveries is presented Table A-4

Reference Material Recoveries

No reference material samples were sub tted to the laboratory as field quality control samples for con entional analyses

Precision

All duplicate sample anal ses met the teria for acceptab performance and frequency of analysis. A summary of uplicate results is presented in Tab A-

TABLE A-3. LABORATORY CONTROL SAMPLE RESULTS—CONVENTIONAL ANALYTES

			Percent Recovery[a]	
Data Package	Analyte	Reference Value[b]	LCS-1	LCS-2
	Chloride	200		
	Total organic carbon	0.40		
C00058	Chloride	200	100	100
	Total organic carbon	0.10	95	96

[a] Control limit for laboratory control sample recovery is 80–120 percent, in accordance with the data quality objective for bias established for this project (PTI 1991a).

[b] Values are reported in mg/kg for chloride and percent of total sample weight for total organic carbon.

TABLE A-4. MATRIX SPIKE RECOVERIES — CONVENTIONAL ANALYTES

Sample Identifiers						
Data Package	Sample No.	Station		Sample ID	Analyte	Percent[a] Recovery
					Chloride	103
					Total organic carbon	97
C00058	S20006	S211	08/24/93	S211	Chloride	NC[b]
					Total organic carbon	89

[a] Control limit for matrix spike recovery is 75–125 percent, in accordance with the data quality objectives established for this project (PTI 1991a).

[b] NC - not calculated; original concentration was ≥4 times the spike concentration

TABLE A-5. RELATIVE PERCENT DIFFERENCE OF LABORATORY DUPLICATES— CONVENTIONAL ANALYTES

Sample Identifiers								
Data Package	Sample No.	Station	Sampling Date	Sample ID	Analyte	Units	Mean	Relative[a] Percent Difference
					Calcium carbonate	percent		2
					Chloride	mg/kg		2
					Total organic carbon	percent		5
					Sand	percent		6
					Silt	percent		3
					Clay	percent		1
					Moisture	percent		<1
C00058	S20006	S211	08/24/93	S211	Calcium carbonate	percent	76.6	1
					Chloride	mg/kg	8,870	2
					Total organic carbon	percent	2.1	9
					Sand	percent	2.5	15
					Silt	percent	17	3
					Clay	percent	2.7	13
					Moisture	percent	78.0	<1

Note: Control limit for laboratory duplicates is 35 relative percent difference.

alyte Quantification and Method Detection Limits

The calculations for analyte quantification and method detection limits were acceptable for all target analytes. All method detection limits met project DQOs.

Field Quality Control

No field quality control samples were submitted to the laboratory as field quality control samples for conventional analyses.

QUALITY ASSURANCE REVIEW SUMMARY—SITE AND TARGET ANALYTE LIST METALS IN SEDIMENT SAMPLES

A quality assurance review of laboratory data was completed for site metals (cadmium, calcium, chromium, copper, lead, magnesium, total mercury, nickel, sodium, and zinc) in 10 surface sediment samples and for target analyte list (TAL) metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, total mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc) and cyanide in 5 surface sediment samples. These data are associated with the 1993 supplemental field investigation conducted at the East Flume, a tributary of Onondaga Lake (PTI 1993). All data are acceptable for the uses identified in the work plan (PTI 1991b). Qualifier codes have been added to some of the accepted results to indicate minor irregularities in the analyses that could affect the bias or precision of the reported value.

SUMMARY OF QUALIFIED DATA

A total of 100 site metal and 120 TAL metal analytical results were reported by the laboratory for the 15 surface sediment analyses. Of these results, 90 site metals (90 percent) and 95 TAL metals (79 percent) were acceptably reported at a concentration above the method detection limit and 10 site metals (10 percent) and 25 TAL metals (21 percent) were reported as undetected (the method detection limit was reported by the laboratory with a *U* qualifier). During the quality assurance review, 22 site metals (22 percent) and 15 TAL metals (12 percent) were qualified as estimated (*J*). No data were rejected during the quality assurance review.

A mary lts for uality trol procedures empl yed by the laboratory for site metals and TAL metals presented Table A-6.

Qualifiers were assigned uring the quality assurance review for the foll ing reasons:

A *J* qualifier gned to mercury results because their matrix duplicate results exceeded the trol li ts

A *J* ualifier was assigned to all 5 zinc results because their serial dilution results exceeded the control limits

A *J* qualifier assigned to selenit result because the graphite furnace analytical spike recovery exceeded the control limits

A qualifier was assigned to 0 lead results and selenium results because the associated matrix spike recoveries exceeded the control limits

A *J* qualifier was assigned to cadmi results because the associated inductively coupled plasma-atomic absorption spectrometry (ICP) contract-required detection limi (CRDL) standard (CRI) recovery exceeded the tro limits.

SAMPLE DELIVERY GROUPS

The 15 surface sediment samples were analyzed in 2 SDGs (Table A-7). The data packages for these SDGs tained all documentati and data necessary to perform complete quality assurance review

TABLE A-6. SUMMARY OF QUALITY CONTROL CHECKS— SITE METALS AND TARGET ANALYTE LIST METALS

Quality Control Check	Status	Comment
Completeness	Acceptable	No data rejected
Holding times	Acceptable	
Analytical methods	Acceptable	
Instrument performance		
Initial calibration	Acceptable; qualified for: cadmium	See *Initial Calibration* section
Initial and continuing calibration verification	Acceptable	
Initial and continuing calibration blanks	Acceptable	
Method blank analyses	Acceptable	
Instrument-specific quality control procedures		
Inductively coupled plasma-atomic absorption spectrometry	Acceptable; qualified for: zinc	See *Serial Dilution of Samples for ICP Analysis* section
Graphite furnace atomic absorption spectrometry	Acceptable; qualified for: selenium	See *Quality Control Procedures for GFAA* section
Accuracy (bias or recovery)		
Laboratory control sample recoveries	Acceptable	
Matrix spike recoveries	Acceptable; qualified for: lead selenium	Possible bias for lead and selenium; see *Matrix Spike Recoveries* section
Reference material recoveries	Not applicable	None submitted
Precision	Acceptable; qualified for: mercury	See *Precision* section
Analyte quantification and method detection limits	Acceptable	
Field quality control	Not applicable	None submitted
OVERALL ASSESSMENT	ACCEPTABLE; no serious concerns	Qualifier codes added to selected results; see *Summary of Qualified Data* section

TABLE A-7. SAMPLES IN EACH SAMPLE DELIVERY GROUP— SITE METALS AND TARGET ANALYTE LIST METALS

Station	Date	Sample ID	Type	Sample No.
	08/24/93	S210	LAKE-SEDT	S20001
	08/24/93	S210	LAKE-SEDT	S20002
	08/24/93	S211	LAKE-SEDT	S20004
	08/24/93	S211	LAKE-SEDT	S20005
	08/24/93	S212	LAKE-SEDT	S20007
	08/24/93	S212	LAKE-SEDT	S20008
	08/24/93	S213	LAKE-SEDT	S20010
	08/24/93	S213	LAKE-SEDT	S20011
	08/24/93	S214	LAKE-SEDT	S20013
	08/24/93	S214	LAKE-SEDT	S20014
	08/24/93	S210	LAKE-SEDT	S20003
	08/24/93	S211	LAKE-SEDT	S20006
	08/24/93	S212	LAKE-SEDT	S20009
	08/24/93	S213	LAKE-SEDT	S20012
	08/24/93	S214	LAKE-SEDT	S20015

[a] All samples in SDG V00057 were analyzed for site metals.

[b] All samples in SDG V00058 were analyzed for TAL metals and cyanide.

ATA QUALITY ASSESSMENT

The specific quality control results associated with the data are discussed below, including holding times, methodology, system performance, and analytical accuracy (bias and precision). Data quality was assessed in terms of EPA CLP requirements (U.S. EPA 1991a) and DQOs established for this project (PTI 1991a).

Completeness

The results reported by the laboratory for site and TAL metals analyses in sediment samples were 100 percent complete and met the project DQO. No sediment data were rejected during the quality assurance review.

Holding Times

All analytical holding time constraints and sample preservation requirements (PTI 1991a) were met for all samples.

Analytical Methods

The analyses for site and TAL metals were completed according to the EPA CLP statement of work (SOW) ILM02.1 (U.S. EPA 1991a).

Instrument Performance

The results for the initial and continuing calibrations associated with all site and TAL metals analyses in the sediment samples are described below.

Initial Calibration

The initial calibrations performed for all site and TAL metals met the criteria for acceptable performance and frequency of analysis, with the exception of cadmium in SDG I00057. The final CRI recovery for cadmium (121.4 percent) exceeded the control limit of 80–120 percent recovery for results near the CRDL. Because the bias is high, only cadmium sample results above the instrument detection limit (IDL) were qualified. Cadmium results in 2 site metals samples were qualified *J* during the quality assurance review.

Initial and Continuing Calibration Verification

The initial and continuing calibration verifications met the criteria for acceptable performance and frequency of analysis.

Initial and Continuing Calibration Blanks

The initial and continuing calibration blanks analyzed for all site and TAL metals met the criteria for acceptable performance and frequency of analysis, with the following exceptions. Several continuing calibration blank results exceeded the control limits (concentrations greater than 2 times the IDL) for barium, magnesium, and zinc. The concentration of these analytes in all associated samples exceeded 5 times the concentration in the blanks, so no data were qualified. In addition, nickel concentrations in several blanks exceeded the CRDL. As required by U.S. EPA (1991a), the affected samples were reanalyzed, with no further contamination observed; therefore, no nickel results were qualified.

Method Blank Analyses

No site or TAL metals were observed at levels above 2 times the IDL in any method blanks.

Instrument-Specific Quality Control Procedures

Instrument-specific quality control procedures for analyses by ICP include interference check samples and serial dilution of field samples. For analyses by graphite furnace atomic absorption spectrometry (GFAA), quality control procedures include analysis of post-digestion spikes and may also include analysis by the method of standard additions. Results for these procedures are evaluated below.

Interference Check Samples for ICP Analyses

All interference check sample results met the criteria for acceptable performance and frequency of analysis.

Serial Dilution of Samples for ICP Analyses

All serial dilution results met the criteria for acceptable performance and frequency of analysis, with the exception of zinc in both SDGs. All 15 results were qualified *J* during the quality assurance review.

Quality Control Procedures for GFAA

GFAA quality control procedures were completed as required (U.S. EPA 1991a) and met control limits, with one exception. The post digestion spike recovery for selenium in one sample exceeded the control limit and was qualified *J* during the quality assurance review.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (LCS, matrix spike, and reference material recoveries) and precision (laboratory duplicates).

Laboratory Control Sample Recoveries

The recoveries reported for all LCS analyses met the criteria for acceptable performance and frequency of analysis. A summary of LCS recoveries is presented in Table A-8.

Matrix Spike Recoveries

The recoveries reported for all matrix spike analyses met the criteria for acceptable performance and frequency of analysis, with the exception of lead in the site metals samples and selenium in the TAL metals samples. Lead results in all 10 site metals samples and selenium results in all 5 TAL metals samples were qualified *J* during the quality assurance review. A summary of matrix spike recoveries is presented in Table A-9.

TABLE A-8. LABORATORY CONTROL SAMPLE RESULTS–SITE METALS AND TARGET ANALYTE LIST METALS

Data Package	Analyte	Reference Value (mg/kg)	Percent Recovery	Control Limits for Percent Recovery
		70	103	50–160
		2,330	97	70–140
		182	82	45–140
		93	100	50–150
		44	97	45–146
		1,530	93	55–150
		14	102	55–153
		137	100	50–155
		306	108	55–150
		78	100	50–155
100058		5,110	71	40–140
		21	154	42–610
		34	88	38–149
		97	94	70–130
		58	89	60–150
		70	103	50–159
		2,330	97	70–140
		182	82	45–140
		120	104	55–150
		93	100	50–150
		62	94	39–158
		8,620	66	60–140
		44	97	45–146
		1,530	93	60–130
		145	89	70–140
		14	102	55–153
		137	100	50–155
		2,560	87	60–130
		33	103	51–160
		64	116	40–175
		306	108	55–150
		140	93	50–150
		40	76	70–135
		78	100	50–155

TABLE A-9. MATRIX SPIKE RECOVERIES— SITE METALS AND TARGET ANALYTE LIST METALS

Sample Identifiers							
Data Package	Sample No.	Station	Sampling Date	Sample ID	Analysis Method	Analyte	Percent[a] Recovery
	S20004			S211	ICP		99
					ICP		85
					ICP		90
					GFAA		57
					CVAA		96
					ICP		82
					ICP		84
I00058	S20006	S2111	08/24/93	S211	ICP		90
					ICP		90
					ICP		89
					ICP		85
					ICP		102
					ICP		86
					ICP		88
					ICP		91
					AA		101
					GFAA		81
					ICP		89
					CVAA		110
					ICP		87
					ICP		52
					ICP		84
					ICP		81
					ICP		90
					ICP		86

[a] Control limit for matrix spike recovery is 75–125 percent, in accordance with the data quality objectives established for this project (PTI 1991a).

AA - atomic absorption spectrometry
CVAA - cold vapor atomic absorption spectrometry
GFAA - graphite furnace atomic absorption spectrometry
ICP - inductively coupled plasma-atomic absorption spectrometry

Reference Material Recoveries

No reference material samples were submitted to the laboratory as field quality control samples.

Precision

The results for all duplicate sample analyses and the frequency of analysis met the criteria for acceptable performance, with the exception of mercury in the TAL samples. Mercury results for all 5 TAL samples were qualified *J* during the quality assurance review. A summary of site and TAL metals duplicate results is presented in Table A-10.

Analyte Quantification and Method Detection Limits

The calculations for analyte quantification and method detection limits acceptable for all target analytes. All method detection limits met project DQOs (PTI 991a).

Field Quality Control

No field quality control samples were submitted to the laboratory as field quality control samples for site or TAL metals analyses.

TABLE A-10. RELATIVE PERCENT DIFFERENCE OF LABORATORY DUPLICATES— SITE METALS AND TARGET ANALYTE LIST METALS

Data Package	Sample Identifiers: Sample No.					Analysis Method	Mean (mg/kg)	Relative Percent Difference
		S211	08/24/93	S211	Cadmium	ICP	--	NC
					Calcium	ICP	330,000	1
					Chromium	ICP	12.0	18
					Copper	ICP	18.7	<1
					Lead	GFAA	26.9	4
					Magnesium	ICP	17,200	1
					Total mercury	CVAA	1.1	
					Nickel	ICP	6.8	18
					Sodium	ICP	6,100	
					Zinc	ICP	118	2
I00058	S20006	S211	08/24/93	S211	Aluminum	ICP	1,640	13
					Antimony	ICP	--	NC
					Arsenic	ICP	9.7	1
					Barium	ICP	138	15
					Beryllium	ICP	--	NC
					Cadmium	ICP	--	NC
					Calcium	ICP	292,000	2
					Chromium	ICP	10.5	6
					Cobalt	ICP	2.2	10
					Copper	ICP	17.2	
					Cyanide	AA	7.0	<1
					Iron	ICP	3,310	1
					Lead	GFAA	20.8	5
					Magnesium	ICP	22,900	<1
					Manganese	ICP	198	<1

Sample Identifiers								
Data Package	Sample No.	Station	Sampling Date	Sample ID	Analyte	Analysis Method	Mean (mg/kg)	Relative Percent Difference
100058					Total mercury	CVAA	1.8	36
					Nickel	ICP	--	NC
					Potassium	ICP	436	22
					Selenium	ICP	--	NC
					Silver	ICP	--	NC
					Sodium	ICP	7,560	<1
					Thallium	ICP	--	NC
					Vanadium	ICP	5.0	3
					Zinc	ICP	123	<1

[a] Control limit for laboratory duplicates is 35 relative percent difference.

-- - sample and/or duplicate was undetected
AA - atomic absorption spectrometry
CVAA - cold vapor atomic absorption spectrometry
GFAA - graphite furnace atomic absorption spectrometry
ICP - inductively coupled plasma-atomic absorption spectrometry
NC - not calculated

QUALITY ASSURANCE REVIEW SUMMARY

SITE AND TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS IN SEDIMENT SAMPLES

A quality assurance review of laboratory data was completed for site volatile organic compounds (VOCs) (benzene, toluene, ethylbenzene, and xylenes [BTEX], monochlorobenzene, dichlorobenzenes [1,2 ,3-, and ,4-isomers], and trichlorobenzenes [1,2,3-, 1,2,4-, and 1,3,5-isomers]) in 10 surface sediment samples and for target compound list (TCL) VOCs in 5 surface sediment samples. These data are associated with the 1993 supplemental field investigation conducted at the East Flume at Onondaga Lake (PTI 1993). All data are acceptable for the uses identified in the work plan (PTI 1991b). Qualifier codes have been added to some of the accepted results to indicate minor irregularities in the analyses that could affect the bias or precision of the reported value

SUMMARY OF QUALIFIED DATA

A total of 110 site VOC and 165 TCL VOC analytical results were reported by the laboratory for the 15 surface sediment samples. Of these results, 56 site VOCs (51 percent) and 23 TCL VOCs (14 percent) were reported at a concentration above the quantification limit, 34 site VOCs (31 percent) and 133 TCL VOCs (81 percent) were reported as undetected (the quantification limit was reported by the laboratory with a *U* qualifier), and 20 site VOCs (18 percent) and 9 TCL VOCs (5 percent) were reported as detected at levels below the quantification limit. All results reported at concentrations below the quantification limit were qualified as estimated (i.e., a *J* qualifier was attached by the laboratory).

During the quality assurance review, 11 TCL VOC results (7 percent) were restated as undetected because of method blank contamination. No data were rejected during the quality assurance review. A summary of results for quality control procedures employed by the laboratory is presented in Table A-11.

SAMPLE DELIVERY GROUPS

The 15 surface sediment samples were analyzed in 2 SDGs (Table A-12). The data packages for these SDGs contained all documentation and data necessary to perform a complete quality assurance review.

DATA QUALITY ASSESSMENT

The specific quality control results associated with the data are discussed below, including holding times, methodology, system performance, and analytical accuracy (bias and precision). Data quality was assessed in terms of EPA CLP requirements (U.S. EPA 1991b) and DQOs established for this project (PTI 1991a).

Completeness

The results reported by the laboratory for all site and TCL VOC analyses in surface sediment samples were 100 percent complete and met the project DQO. No data were rejected during the quality assurance review.

TABLE A-11. SUMMARY OF QUALITY CONTROL CHECKS— SITE AND TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS

Quality Control Check	Status	Comment
Completeness	Acceptable	No data rejected
Holding times	Acceptable	
Analytical methods	Acceptable	
Instrument performance		
Mass spectrometer tuning	Acceptable	
Calibration	Acceptable	
Method blank analyses	Acceptable; qualified for: acetone 2-butanone Methylene Chloride	See *Method Blank Analyses* section
Accuracy (bias or recovery)		
Surrogate compound recoveries	Acceptable	
Laboratory control sample recoveries	Acceptable	
Matrix spike recoveries	Acceptable	
Precision	Acceptable	
Internal standard performance	Acceptable	
Target compound identification	Acceptable	
Tentatively identified compounds	Acceptable; all compounds	See *Tentatively Identified Compounds* section
Compund quantification and detection limits	Acceptable; qualified for: all results reported at concentrations below the quantification limit	See *Compound Quantification and Detection Limits* section
Field quality control	Acceptable	
OVERALL ASSESSMENT	ACCEPTABLE; no serious concerns	Qualifier codes added to selected results; see *Summary of Qualified Data* section

TABLE A-12 SAMPLES IN EACH SAMPLE DELIVERY GROUP— SITE AND TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS

Station	Sampling Date	Sample ID	Type	Sample No.
	08/24/93	S210	LAKE-SEDT	S20001
	08/24/93	S210	LAKE-SEDT	S20002
	08/24/93	S211	LAKE-SEDT	S20004
	08/24/93	S211	LAKE-SEDT	S20005
	08/24/93	S212	LAKE-SEDT	S20007
	08/24/93	S212	LAKE-SEDT	S20008
	08/24/93	S213	LAKE-SEDT	S20010
	08/24/93	S213	LAKE-SEDT	S20011
	08/24/93	S214	LAKE-SEDT	S20013
	08/24/93	S214	LAKE-SEDT	S20014
	08/24/93	TBLANK-S	LAKE-SEDT	S20016
	08/24/93	S210	LAKE-SEDT	S20003
	08/24/93	S211	LAKE-SEDT	S20006
	08/24/93	S212	LAKE-SEDT	S20009
	08/24/93	S213	LAKE-SEDT	S20012
	08/24/93	S214	LAKE-SEDT	S20015
	08/24/93	TBLANK-S	LAKE-SEDT	S20016

[a] All samples in SDG V00057 were analyzed for site volatile organic compounds.

[b] All samples in SDG V00058 were analyzed for target compound list volatile organic compounds.

Holding Tim

All anal cal ho ding me constra and sampl rese ation r PTI 99 were met all sam

Analytical Me hod

The analyses or VOCs were co pleted usin modified ersion of CLP OW OLM0 (U EPA 99 Tl mod fied target compound included BTEX monoc orobenzen loroben some ch robenzenes 3- m add po (bromo- fluorobenzene used Tl al for TCL VOC were completed accor the CLP SOW OLM0 (U EPA 99)

Instrumen Performan

The performance the anal tical documented the laboratory and verified urin the ual ty assurance review acceptab N cl ges instrumen perfor mance were ieated thai ted the egradati of data ual ty

Mass Spe :tr T in

A trumen an performance hec made t labor tory prior all anal iceptab

Calibration

The initial and continuing calibrations performed for all site and TCL VOCs met the criteria for acceptable performance and frequency of analysis

Method Blank Analyses

Acetone, 2-butanone, and methylene chloride were the only target compounds detected in the method blanks for the TCL VOC analyses; no target compounds were detected in the method blanks for the site VOC analyses. During the quality assurance review 11 results (4 for acetone, 2 for 2-butanone, and 5 for methylene chloride) associated with the contaminated method blanks were restated as undetected. A *U* qualifier was applied to 10 of these results at the reported concentration, and 1 result for methylene chloride was restated to the detection limit and assigned a *U* qualifier.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (surrogate compound, LCS, and matrix spike recoveries) and precision (matrix spike duplicates)

Surrogate Compound Recoveries

The recoveries reported by the laboratory for the surrogate (system monitoring) compound added to all site VOC sediment samples and the 3 surrogate compounds added to all TCL VOC sediment samples met the criteria for acceptable performance, with 1 exception. For the analyses performed for TCL VOCs, the surrogate recovery reported for toluene-d_8 in one sample (Sample S20015) was below the lower quality

control limit. No data associated with the TCL VOC analyses were qualified because all other surrogate recoveries were acceptable and these outliers appear to be an isolated incident. A summary of surrogate recoveries is presented in Table A-13.

Laboratory Control Sample Recoveries

The recoveries reported for all LCS analyses met the criteria for acceptable performance and frequency of analysis. A summary of LCS recoveries is presented in Table A-14.

Matrix Spike Recoveries

The recoveries reported for the matrix spike and matrix spike duplicate samples and the frequency of analysis met the criteria for acceptable performance, with the exception of 7 matrix spike recoveries which fell below the lower quality control limit of 50 percent. Data are not qualified based on matrix spike results alone (U.S. EPA 1991c); therefore, no results were qualified during quality assurance review. A summary of matrix spike and matrix spike duplicate recoveries is presented in Table A-15.

Precision

The results for all duplicate matrix spike analyses met the criteria for acceptable performance and frequency of analysis, with two exceptions. The relative percent difference (RPD) for 2 sets of matrix spikes associated with site VOC analyses were outside quality control limits. Data are not qualified based on matrix spike data alone (U.S. EPA 1991c); therefore, no results were qualified during quality assurance review. A summary of duplicate matrix spike results is presented in Table A-15.

TABLE A-13. PERCENT RECOVERY FOR SURROGATE COMPOUNDS— SITE AND TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS

Sample Identifiers					Percent Recovery[a]		
Data Package	Sample No.	Station	Sampling Date	Sample ID	Toluene-d_8	Bromofluorobenzene	1,2-Dichloroethane-d_4
			08/24/93			96	
			08/24/93			85	
			08/24/93			93	
			08/24/93			97	
			08/24/93			95	
			08/24/93			98	
			08/24/93			103	
			08/24/93			99	
			08/24/93			99	
			08/24/93			81	
			08/24/93			100	
Mean						98	
Standard deviation						3	
Range					–	93–103	
V00058	S20003	S210	08/24/93	S210	102	98	100
	S20006	S211	08/24/93	S211	101	101	97
	S20009	S212	08/24/93	S212	100	96	96
	S20012	S213	08/24/93	S213	101	95	99
	S20015	S214	08/24/93	S214	79	86	85
Mean					97	95	95
Standard deviation					10	6	6
Range					79–102	86–101	85–99

[a] CLP surrogate recovery control limit for toluene-d_8 is 84–138 percent, for bromofluorobenzene is 59–113 percent, and for 1,2-dichloroethane-d_4 is 70–121 percent.

[b] -- Samples in SDG V00057 were analyzed for site VOCs, therefore, only one surrogate compound was required.

TABLE A-14. LABORATORY CONTROL SAMPLE RESULTS— SITE AND TARGET COMPOUND LIST VOLATILE ORGANIC COMPOUNDS

Data Package	Analyte	Reference Value (µg/kg)	Percent Recovery[ab] LCS-1	Percent Recovery[ab] LCS-2
	1,2-Dichlorobenzene	50		
	1,3-Dichlorobenzene	50		
	1,4-Dichlorobenzene	50		
	1,2,3-Trichlorobenzene	50		
	1,2,4-Trichlorobenzene	50		
	1,3,5-Trichlorobenzene	50		
	Monochlorobenzene	50		
V00057	1,2-Dichlorobenzene	6,250	102	108
	1,3-Dichlorobenzene	6,250	108	107
	1,4-Dichlorobenzene	6,250	104	104
	1,2,3-Trichlorobenzene	6,250	101	103
	1,2,4-Trichlorobenzene	6,250	100	103
	1,3,5-Trichlorobenzene	6,250	99	101
	Monochlorobenzene	6,250	101	102
V00058	1,1-Dichloroethene	50	107	113
	Trichloroethene	50	108	106
	Benzene	50	100	102
	Toluene	50	101	104
	Monochlorobenzene	50	109	111
V00058	1,1-Dichloroethene	6,250	93	90
	Trichloroethene	6,250	102	104
	Benzene	6,250	98	99
	Toluene	6,250	95	98
	Monochlorobenzene	6,250	100	104

[a] Control limits for laboratory control sample recovery are 50–150 percent, in accordance with the data quality objective for bias established for this project (PTI 1991a).

TABLE A-15. MATRIX SPIKE AND MATRIX SPIKE DUPLICATE RECOVERIES – SITE AND TARGET COMPOUND LIST VOLATILE ORGNAIC COMPOUNDS

						Percent Recovery		
					Analyte	Matrix Spike	Spike Duplicate	RPD
V00057	S20004	S211	08/24/93	S211	1,2-Dichlorobenzene	119	146	29
					1,2,3-Trichlorobenzene	41	41	0
					1,2,4-Trichlorobenzene	38	40	5
					1,3-Dichlorobenzene	72	72	0
					1,3,5-Trichlorobenzene	42	50	17
					1,4-Dichlorobenzene	116	146	23
					Monochlorobenzene	97	109	12
V00057	S20014	S214	08/24/93	S214	1,2-Dichlorobenzene	36	108	100
					1,2,3-Trichlorobenzene	79	76	4
					1,2,4-Trichlorobenzene	87	81	7
					1,3-Dichlorobenzene	82	91	10
					1,3,5-Trichlorobenzene	88	80	10
					1,4-Dichlorobenzene	33	95	97
					Monochlorobenzene	82	91	10
V00058	S20006	S211	08/24/93	S211	1,1-Dichloroethene	104	103	1
					Trichloroethene	99	98	1
					Benzene	106	92	14
					Toluene	126	89	34
					Monochlorobenzene	117	95	21
V00058	S20015	S214	08/24/93	S214	1,1-Dichloroethene	73	76	4
					Trichloroethene	80	83	4
					Benzene	83	84	1
					Toluene	75	76	1
					Monochlorobenzene	68	68	0

a RPD - relative percent difference

b Control limits for matrix spike and matrix spike duplicate are 50–150 percent recovery and 50 RPD, in accordance with the data quality objectives established for this project (PTI 1991a).

TABLE A-16. SUMMARY OF QUALITY CONTROL CHECKS— TARGET COMPOUND LIST SEMIVOLATILE ORGANIC COMPOUNDS

Quality Control Check	Status	Comment
Completeness	Acceptable	No data rejected
Holding times	Acceptable	
Analytical methods	Acceptable	
Instrument performance	Acceptable	
Initial calibration	Acceptable	
Continuing calibration	Acceptable	
Method blank	Acceptable	
Accuracy (bias or recovery)		
Surrogate compound recoveries	Acceptable	
Laboratory control sample recoveries	Acceptable	
Matrix spike recoveries	Acceptable	
Precision	Acceptable	
Internal standards performance	Acceptable	
Target compound identification	Acceptable	
Tentatively identified compounds	Acceptable; all compounds	See *Tentatively Identified Compounds* section
Compound quantification and method detection limits	Acceptable; qualified for: all results reported at concentrations below the quantification limit	See *Compound Quantification and Method Detection Limits* section
Field quality control	Not applicable	None submitted
OVERALL ASSESSMENT	**ACCEPTABLE; no serious concerns**	**Qualifier codes added to selected results; see *Summary of Qualified Data* section**

Internal Standard Performan

Acceptance teria for in. al standard reten ti and area count were met for all analyses performed.

Targe Compound Identification

The identification of all site and target compounds reported at concentrations either above or bel the detection limit was acceptabl

Tentatively Identified Compounds

Several tentatively identified compounds (TICs mostly substituted benzenes, were detected in the samples A *J* qualifier was applied to all TIC results during the quality assurance revi in accordance th U. EPA (99

Analyte Quantification and M thod D tection Limits

The calculations for analyte q itification were acceptable for all target analytes. All results reported by the laboratory that were bel the detection limit were qualified as estimates (a *J* qualifier assigned by both the laboratory and during validation A total of 20 site VOCs and 9 TCL VOCs detected at levels below the detection limi All detecti li ts reported by the laboratory were acceptable and met project DQOs

Field Quality Control

The results for the field quality control samples associated with the surface sediment samples were acceptable. The field quality control samples consisted of 2 travel blanks, and no site or target compounds were detected.

QUALITY ASSURANCE REVIEW SUMMARY—

TARGET COMPOUND LIST SEMIVOLATILE ORGANIC COMPOUNDS IN SURFACE SEDIMENT SAMPLES

A quality assurance review of laboratory data was completed for TCL semivolatile organic compounds (SVOCs) in 5 surface sediment samples. These samples were collected for the 1993 supplemental field investigation conducted at the East Flume at Onondaga Lake (PTI 1993). All data are acceptable for the uses identified in the work plan (PTI 1991b). Qualifier codes have been added to some of the accepted results to indicate minor irregularities in the analyses that could affect the bias or precision of the reported value.

SUMMARY OF QUALIFIED DATA

A total of 320 SVOC analytical results were reported by the laboratory for the 5 surface sediments. Of these results, 41 (13 percent) were acceptably reported at a concentration above the quantification limit, 217 (68 percent) were reported as undetected (the quantification limit was reported by the laboratory with a *U* qualifier), and 62 (19 percent) were reported as detected at concentrations below the quantification limit. All results reported at concentrations below the quantification limit were qualified as estimated (i.e., a *J* qualifier was attached by the laboratory). No additional data were qualified, and no results were rejected during the quality assurance review. A summary of results for quality control procedures employed by the laboratory is presented in Table A-16.

TABLE A-17. SAMPLES IN EACH SAMPLE DELIVERY GROUP— TARGET COMPOUND LIST SEMIVOLATILE ORGANIC COMPOUNDS

Station	Sampling Date	Sample ID	Type	Sample No
	08/24/93	S210	LAKE-SEDT	S20003
	08/24/93	S211	LAKE-SEDT	S20006
	08/24/93	S212	LAKE-SEDT	S20009
	08/24/93	S213	LAKE-SEDT	S20012
	08/24/93	S214	LAKE-SEDT	S20015

SAMPLE DELIVERY GROUPS

The 5 surface sediment samples were analyzed for TCL SVOCs in 1 SDG (Table A-17). The data package for this SDG contained all documentation and data necessary to perform a complete quality assurance review.

DATA QUALITY ASSESSMENT

The specific quality control results associated with the data are discussed below, including holding times, methodology, instrument performance, and analytical accuracy (bias and precision). Data quality was assessed in terms of EPA CLP requirements (U.S. EPA 1991c) and DQOs established for this project (PTI 1991a).

Completeness

The results reported by the laboratory for all TCL SVOC analyses in the surface sediment samples were 100 percent complete and met the project DQO. No data were rejected during the quality assurance review.

Holding Times

All analytical holding time constraints and sample preservation requirements (PTI 1991a) were met for all samples.

TABLE A-18. PERCENT RECOVERY FOR SURROGATE COMPOUNDS— TARGET COMPOUND LIST SEMIVOLATILE ORGANIC COMPOUNDS

Sample Identifiers					Percent Recovery[a]							
Data Package	Sample No.	Station	Sampling Date	Sample ID	2-Chlorophenol-d_4	2-Fluorophenol	1,2-Dichlorobenzene-d_4	2-Fluorobiphenyl	Nitrobenzene-d_5	Phenol-d_5	2,4,6-Tribromophenol	Terphenyl-d_{14}
S00058	S20003	S210	08/24/93	S210	53	46	32	74	48	54	72	85
	S20006	S211	08/24/93	S211	37	46	22	49	37	44	52	88
	S20009	S212	08/24/93	S212	46	43	36	59	45	46	53	70
	S20012	S213	08/24/93	S213	40	37	24	48	39	61	52	66
	S20015	S214	08/24/93	S214	56	49	36	55	48	61	55	62
				Mean	46	44	30	57	43	53	57	74
				Standard Deviation	8	5	7	11	5	8	9	12
				Range	37–56	37–49	22–36	48–74	37–48	44–61	52–72	62–88

[a] U.S. EPA (1991b) quality control limits for surrogate compounds are as follows:

2-Chlorophenol-d_4	20–130 percent
2-Fluorophenol	25–121 percent
1,2-Dichlorobenzene-d_4	20–130 percent
2-Fluorobiphenyl	30–115 percent
Nitrobenzene-d_5	23–120 percent
Phenol-d_5	24–113 percent
2,4,6-Tribromophenol	19–122 percent
Terphenyl-d_{14}	18–137 percent

Analytical Methods

The analyses for TCL SVOCs were completed according to the EPA CLP SOW OLM01.8 (U.S. EPA 1991b), modified to achieve the lower detection limits required for the investigation. All modifications are outlined in the project quality assurance project plan (PTI 1991a)

Instrument Performance

The performance of the analytical system documented by the laboratory and verified during the quality assurance review was acceptable. No changes in instrument performance were indicated that would have resulted in the degradation of data quality

Mass Spectrometer Tuning

The mass spectrometer tuning checks made by the laboratory prior to sample analyses were acceptable.

Calibration

The results for the initial and continuing calibrations associated with all surface sediment sample analyses met the criteria for acceptable performance and frequency of analysis

Method Blank Analyses

No TCL SVOCs were detected in any method blanks

Accuracy

The accuracy of the analytical results evaluated in the foll sections terms of anal tical bias (surrogate compound LCS and matrix spike eries) and precision (matrix spike duplicates)

Surrogate Compound R veries

The recoveries reported y the laboratory for the acid- tractable and 4 base/neutral tractable surrogate compounds added all surface sedimen samples met the teria for acceptable performance. A mmary of surrogate compo recoveri presented in Tabl A- 8.

Laboratory Control Sample Recoveries

The recoveries reported for all LCS analy: met the teria for acceptable performance and frequency of analysis th ception The LCS recovery reported for N-nitroso-di *n*-propylamine percent below the percen lower CLP quality itrol limit. No data were qualified for this one exceedance because the outlier recovery was only slightly below the lower CLP acceptance teri and the compound was not detected in any sample. A summary LCS recoveries presented 9 Table A-

Matrix Spike Recoveries

The recoveries reported for all trix spike and matrix spike uplicate samples and the frequency of analysis met the teria for acceptab performance th the ception of recoveries. A total of matrix spike and matrix spike duplicate recoveri were below the lower CLP quality control limit. Data are not ualified based LCS or

TABLE A-19. LABORATORY CONTROL SAMPLE RESULTS— TARGET COMPOUND LIST SEMIVOLATILE ORGANIC COMPOUNDS

Data Package	Analyte	Reference Value (µg/kg)	Percent Recovery[a] LCS-1	LCS-2
	4-Chloro-3-methylphenol	625		
	2-Chlorophenol	625		
	1,4-Dichlorobenzene	417		
	2,4-Dinitrotoluene	417		
	4-Nitrophenol	625		
	1,2,4-Trichlorobenzene	417		
	Acenaphthene	417		
	N-Nitroso-di-*n*-propylamine	417		
	Pentachlorophenol	625		
	Phenol	625		
	Pyrene	417		

[a] U.S. EPA (1991b) quality control limits for spike percent recoveries are as follows:

4-Chloro-3-methylphenol	26–103
2-Chlorophenol	25–102
1,4-Dichlorobenzene	28–104
2,4-Dinitrotoluene	28–89
4-Nitrophenol	11–114
1,2,4-Trichlorobenzene	38–107
Acenaphthene	31–107
N-Nitroso-di-*n*-propylamine	41–126
Pentachlorophenol	17–109
Phenol	26–90
Pyrene	35–142

TABLE A-20. MATRIX SPIKE AND MATRIX SPIKE DUPLICATE RECOVERIES — TARGET COMPOUND LIST SEMIVOLATILE ORGANIC COMPOUNDS

Data Package	Sample No.	Station	Sampling Date	Sample ID	Analyte	Percent Recovery			Quality Control Limits	
						Matrix Spike	Spike Duplicate		Percent Recovery	
S00058	S20006	S211			4-Chloro-3-methylphenol	54	50	8	26–103	33
					2-Chlorophenol	34	31	9	25–102	50
					1,4-Dichlorobenzene	14	39	94	28–104	27
					2,4-Dinitrotoluene	25	25	0	28–89	47
					4-Nitrophenol	46	34	30	11–114	50
					1,2,4-Trichlorobenzene	23	40	54	38–107	23
					Acenaphthene	44	51	15	31–137	19
					n-Nitroso-di-*n*-propylamine	37	48	26	41–126	38
					Pentachlorophenol	47	50	6	17–109	47
					Phenol	40	42	5	26–90	35
					Pyrene	59	48	21	35–142	36

[a] RPD - relative percent difference

[b] Control limits for matrix spike and matrix spike duplicate are 50–150 percent recovery and 50 RPD, in accordance with the data quality objectives established for this project (PTI 1991a).

matrix spike results alone (U.S. EPA 1991c); therefore, no results were qualified during the quality assurance review. A summary of matrix spike and matrix spike duplicate recoveries is presented in Table A-20.

Precision

The results for all duplicate matrix spike analyses and the frequency of analysis met the criteria for acceptable performance, with 2 exceptions. Compound-specific RPD criteria were not met for 2 matrix spike results. In addition, 1 duplicate LCS did not meet the control limit for precision (see Table A-19). No results were qualified during the quality assurance review because the exceedances were associated with anomalous recoveries. A summary of duplicate matrix spike results is presented in Table A-20.

Internal Standards Performance

Acceptance criteria for internal standard retention time and area counts were met for all samples.

Target Compound Identification

The identification of all target analytes reported as detected at concentrations either above or below the quantification limit was acceptable.

Tentatively Identified Compounds

Several TICs were detected in the samples, including various hydrocarbons and several unidentifiable compounds. A *J* qualifier was applied to all TIC results during the quality

TABLE A-21. SUMMARY OF QUALITY CONTROL CHECKS—TCL PESTICIDES AND POLYCHLORINATED BIPHENYLS; POLYCHLORINATED BIPHENYLS AND CHLORINATED BENZENES

Quality Control Check	Status	Comment
Completeness	Acceptable	No data rejected
Holding times	Acceptable; qualified for: all 50 chlorinated benzenes	See *Holding Times* section
Analytical methods	Acceptable	
Instrument performance (calibration)	Acceptable	
Method blank analyses	Acceptable	
Accuracy (bias or recovery)		
Surrogate compound recoveries	Acceptable	
Laboratory control sample recoveries	Acceptable	
Matrix spike sample recoveries	Acceptable	
Precision	Acceptable	
Target compound identification	Acceptable	
Compound quantification and method detection limits	Acceptable; qualified for: all results reported at concentrations below the quantification limit	See *Compound Quantification and Method Detection Limits* section
Field quality control samples	Not applicable	None submitted
OVERALL ASSESSMENT	ACCEPTABLE; no serious concerns	Qualifier codes added to selected results; see *Summary of Qualified Data* section

assurance review in accordance with U.S. EPA (1991c). A *J* qualifier is assigned to all non-target compound results because the identification is tentative and because no calibration curve is available to allow rigorous quantification.

Target Compound Quantification and Method Detection Limits

The calculations for target compound quantification and method detection limits were acceptable for all target analytes. A total of 62 TCL SVOCs were detected at levels below the detection limit; these results were qualified at estimates (assigned a *J* qualifier by the laboratory and during validation). All reported detection limits met the project DQO.

Field Quality Control

No field quality control samples were submitted to the laboratory as field quality control samples for TCL SVOC analyses.

QUALITY ASSURANCE REVIEW SUMMARY—

TARGET COMPOUND LIST PESTICIDES AND POLYCHLORINATED BIPHENYLS; POLYCHLORINATED BIPHENYLS AND CHLORINATED BENZENES IN SURFACE SEDIMENT SAMPLES

A quality assurance review of laboratory data was completed for TCL pesticides and polychlorinated biphenyls (PCBs) in 5 surface sediment samples and for PCBs and chlorinated benzenes (i.e., 1,2,3,4-, 1,2,3,5-, and 1,2,4,5-tetrachlorobenzene, pentachlorobenzene, and hexachlorobenzene) in 10 surface sediment samples. These data are associated with the 1993 supplemental field investigation conducted at the East Flume at Onondaga Lake (PTI 1993). All data are acceptable for the uses identified in the work plan (PTI 1991b). Qualifier codes have been added to some of the accepted results to indicate minor irregularities in the analyses that could affect the bias or precision of the reported value.

SUMMARY OF QUALIFIED DATA

A total of 140 TCL pesticide and PCB, 70 PCB, and 50 chlorinated benzene analytical results were reported by the laboratory for the 15 surface sediments. Of these results, 7 (10 percent) PCB and 40 (80 percent) chlorinated benzene results were acceptably reported at a concentration above the quantification limit, all 140 (100 percent) TCL pesticide and PCB results, 54 (77 percent) PCB, and 10 (20 percent) chlorinated benzene results were reported as undetected (the quantification limit was reported by the laboratory with a *U* qualifier), and 9 (13 percent) PCB results were reported as detected at concentrations below the quantification limit. All results reported at concentrations below

the quantification limit were qualified as estimated (i.e., a *J* qualifier was attached to the results by the laboratory). During the quality assurance review, 40 detected chlorinated benzene and 10 undetected chlorinated benzene results were qualified as estimated (assigned a *J* and *UJ*, respectively) because holding time criteria were not met for required sample reanalyses (see *Holding Time* section for details). No results were rejected. A summary of results for quality control procedures employed by the laboratory is presented in Table A-21.

SAMPLE DELIVERY GROUPS

The 5 surface sediments analyzed for TCL pesticides and PCBs and the 10 surface sediment samples analyzed for PCBs and chlorinated benzenes were analyzed in 2 SDGs (Table A-22). The data packages for these SDGs contained all documentation and data necessary to perform a complete quality assurance review.

DATA QUALITY ASSESSMENT

The specific quality control results associated with the data are discussed below, including holding times, methodology, instrument performance, and analytical accuracy (bias and precision). Data quality was assessed in terms of EPA CLP requirements (U.S. EPA 1991b) and the DQOs established for this project (PTI 1991a).

Completeness

The results reported by the laboratory for all TCL pesticide and PCB, PCB, and chlorinated benzene analyses were 100 percent complete and met the project DQOs, with the exception of specific holding time criteria for the chlorinated benzene analyses. No data were rejected during the quality assurance review.

TABLE A-22. SAMPLES IN EACH SAMPLE DELIVERY GROUP— TARGET COMPOUND LIST PESTICIDES AND POLYCHLORINATED BIPHENYLS; POLYCHLORINATED BIPHENYLS AND CHLORINATED BENZENES

Station	Sampling Date	Sample ID	Type	Sample No.
	08/24/93	S210	LAKE-SEDT	S20003
	08/24/93	S211	LAKE-SEDT	S20006
	08/24/93	S212	LAKE-SEDT	S20009
	08/24/93	S213	LAKE-SEDT	S20012
	08/24/93	S214	LAKE-SEDT	S20015
	08/24/93	S210	LAKE-SEDT	S20001
	08/24/93	S210	LAKE-SEDT	S20002
	08/24/93	S211	LAKE-SEDT	S20004
	08/24/93	S211	LAKE-SEDT	S20005
	08/24/93	S212	LAKE-SEDT	S20007
	08/24/93	S212	LAKE-SEDT	S20008
	08/24/93	S213	LAKE-SEDT	S20010
	08/24/93	S213	LAKE-SEDT	S20011
	08/24/93	S214	LAKE-SEDT	S20013
	08/24/93	S214	LAKE-SEDT	S20014

TABLE A-23. PERCENT RECOVERY FOR SURROGATE COMPOUNDS— TARGET COMPOUND LIST PESTICIDES AND POLYCHLORINATED BIPHENYLS; POLYCHLORINATED BIPHENYLS AND CHLORINATED BENZENES

Data Package	Sample Identifiers: Sample No.		Sampling Date		Percent Recovery: Decachlorobiphenyl[a]		Tetrachloro-*m*-xylene[b]		Dibutylchlorendatee
							1[c]		
	S20003	S210	08/24/93	S210	98	100	78	76	
	S20006	S211	08/24/93	S211	97	111	65	70	
	S20009	S212	08/24/93	S212	78	88	69	68	
	S20012	S213	08/24/93	S213	96	101	78	76	
	S20015	S214	08/24/93	S214	116	124	94	84	--
P00057	S20001	S210	08/24/93	S210					72
	S20002	S210	08/24/93	S210					91
	S20004	S211	08/24/93	S211					67
	S20005	S211	08/24/93	S211					65
	S20007	S212	08/24/93	S212					46
	S20008	S212	08/24/93	S212					67
	S20010	S213	08/24/93	S213					72
	S20011	S213	08/24/93	S213					78
	S20013	S214	08/24/93	S214					47
	S20014	S214	08/24/93	S214					57

[a] Control limit for decachlorobiphenyl and tetrachloro-*m*-xylene surrogate recovery is 60–150 percent; these surrogate compounds were used for target compound list pesticide and polychlorinated biphenyl analyses.

[b] Control limit for dibutylchlorendate surrogate recovery is 20–150 percent; this surrogate compound was used for polychlorinated biphenyl and chlorinated benzene analyses.

[c] Surrogate recoveries reported for analyses performed using primary analytical column.

[d] Surrogate recoveries reported for analyses performed using confirmational analytical column.

Holding Tim

All analytical holdin constraints and samp preservation requirements (PTI 99 a) were met for all samples analyzed for TCL pesticides and PCBs PCBs only The holding time constraint established for the analy of sampl tracts the sampl extracts must be analyzed thin 40 days after th samples are extracted) was not met for the chlorinated benzenes anal

During the quality assurance revi all 50 chlorinated benzene results were qualified as estimated (assigned *J* for detected anal tes and *UJ* for undetected analytes beca of the holding time exceedance

Analytical Methods

The analyses for TCL pesticides and PCBs and PCBs only were completed according to the CLP SOW OLM0 (U EPA 99). The analyses for chlorinated benzene compounds completed according to modificati of EPA SW-846 Method 20 (U. EPA 986) using dual-column gas chromatography th electron capture detection All modifications are tlined in the project quality assurance project plan (PTI 199

Instrument Performan

The performance of the analytical system documented by the laboratory and erified dur ing the quality assurance review was acceptable No changes in instrum performance were indicated that would ha resulted in the degradati f da quality

Calibration

The results for the initial and continuing calibrations performed for all target TCL pesticide and PCB PCB and chlorinated benzene analytes met the criteria for acceptable performance and frequency of analysis.

Method Blank Analyses

No target analytes were detected in the method blanks.

Accuracy

The accuracy of the analytical results was evaluated in the following sections in terms of analytical bias (surrogate compound, LCS and matrix spikes) and precision (matrix spike duplicates).

Surrogate Compound Recoveries

The recoveries reported by the laboratory for the surrogate compounds added to all surface sediment sample analyses met the criteria for acceptable performance. A summary of the surrogate compound recoveries is presented in Table A-23.

Laboratory Control Sample Recoveries

The recoveries reported for all LCS analyses met the criteria for acceptable performance and frequency of analysis. A summary of LCS recoveries is presented in Table A-24.

TABLE A-24. LABORATORY CONTROL SAMPLE RESULTS— TARGET COMPOUND LIST PESTICIDES AND POLYCHLORINATED BIPHENYLS; POLYCHLORINATED BIPHENYLS AND CHLORINATED BENZENES

Data Package	Analyte	Reference Value (µg/kg)	Percent Recovery[a] LCS-1	LCS-2
		33		
		17		
		17		
		33		
		33		
		17		
P00057	PCB 1248	84	110	96
	Hexachlorobenzene	15	102	109

[a] U.S. EPA (1991b) quality control limits for matrix spike percent recoveries are as follows:

4,4'-DDT	23–134
Aldrin	34–132
γ-BHC (lindane)	46–127
Dieldrin	31–134
Endrin	42–139
Heptachlor	35–130

Control limits for laboratory control sample recovery is 150 percent, in accordance with the data quality objective for bias established for this project (PTI 1991a).

TABLE A-25. MATRIX SPIKE AND MATRIX SPIKE DUPLICATE RECOVERIES—TARGET COMPOUND LIST PESTICIDES AND POLYCHLORINATED BIPHENYLS; POLYCHLORINATED BIPHENYLS AND CHLORINATED BENZENES

						Percent Recovery[a]			Quality Control Limits	
Data Package					Analyte		Spike Duplicate		Percent Recovery	
	S20006	S211	08/24/93	S211	4,4'-DDT	64	81	23	23–134	50
					Aldrin	48	65	30	34–132	43
					Dieldrin	63	82	26	31–134	38
					Endrin	73	95	26	42–139	45
					Heptachlor	63	78	21	35–130	31
					γ-Hexachlorocyclohexane	33	60	58	46–127	50
P00057	S20004	S211	08/24/93	S211	PCB 1248	115	106	8	50-150	50
	S20004	S211	08/24/93	S211	Hexachlorobenzene	154	172	11	50-150	50

[a] RPD - relative percent difference

Matrix Spike Recoveries

The recoveries reported for all matrix spike and matrix spike duplicate samples and the frequency of analysis met the criteria for acceptable performance, with 3 exceptions. One matrix spike recovery reported for γ-hexachlorocyclohexane (lindane) was below the lower CLP quality control limit and both the matrix spike and spike duplicate recoveries for hexachlorobenzene did not meet control limits for accuracy. No results were qualified during the quality assurance review, because data are not qualified based on matrix spike results alone (U.S. EPA 1991c) and all other results assessed for quality control (e.g., surrogate and LCS recoveries) were acceptable. A summary of matrix spike and matrix spike duplicate recovery results is presented in Table A-25.

Precision

The RPD results for all duplicate matrix spike analyses and the frequency of analysis met the criteria for acceptable performance, with 1 exception. The RPD for γ-hexachlorocyclohexane (lindane) in the matrix spike analysis performed on Sample S20006 was above the CLP quality control limit. No results were qualified during the quality assurance review because data are not qualified based on matrix spike results alone (U.S. EPA 1991c). A summary of duplicate matrix spike results is presented in Table A-25.

Target Compound Identification

The identification of all target analytes reported at concentrations either above or below the quantification limit was determined to be acceptable during the quality assurance review.

Compound Quantification and Method Detection Limits

The calculations for analyte quantification and method detection limits were acceptable for all target analytes. Nine PCB results reported by the laboratory at concentrations below the detection limit were qualified as estimates (assigned a *J* qualifier by the laboratory and during validation). All reported detection limits were acceptable and met project DQOs.

Field Quality Control

PTI. 1991a. Onondaga Lake RI/FS sampling and analysis plan. Volume 2: Quality assurance project plan. Prepared for AlliedSignal Inc., Solvay, NY. PTI Environmental Services, Bellevue, WA.

PTI. 1991b. Onondaga Lake RI/FS work plan. Prepared for AlliedSignal Inc., Solvay, NY. PTI Environmental Services, Bellevue, WA.

PTI. 1993. Onondaga Lake RI/FS supplemental sampling plan—East Flume sediments. Prepared for AlliedSignal Inc., Solvay, NY. PTI Environmental Services, Bellevue, WA.

U.S. EPA 1986. Test methods for evaluating solid waste. Volume 1B: Laboratory manual physical/chemical methods. SW-846. Third Edition. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA 1991a. Contract Laboratory Program statement of work for inorganics analysis, multi-media, multi-concentration. Revision ILM02.1. U.S. Environmental Protection Agency, Washington DC.

U.S. EPA 1991b. Contract Laboratory Program statement of work for organics analysis, multi-media, multi-concentration. Revision OLM01.8. U.S. Environmental Protection Agency, Washington DC.

U.S. EPA. 1991c. National functional guidelines or organic data review. December 1990 (issued 1990 and revised 1991). U.S. Environmental Protection Agency, Washington, DC.